E. Proposed Plans for Dam Removal

1. Wildcat Diversion Dam

a. Site access and mobilization. - Site access to Wildcat Diversion Dam is provided by traveling approximately 1 mile south of Battle Creek Bottom Road on an unimproved (dirt) road to the plateau (or north rim) above the dam, and by foot along a narrow trail to the right abutment of the dam. The damsite is owned by PG&E, but the access road crosses private property. Necessary approvals for site access would have to be obtained from private landowners. Electric power (110 V) is currently available at the site via an overhead transmission line.

It is assumed that a contractor staging area would be established on the right abutment plateau. Construction equipment would probably be transported down to the damsite by helicopter, except for smaller equipment and tools that could be carried down the access trail. Helicopter service may be available from Redding Air Services, Redding, California (phone 530-221-2851) or from Erickson Air-Crane Company, Central Point, Oregon (phone 541-664-7615). The use of a helicopter for site mobilization would probably require removal of the power transmission line at the site. Potential alternative methods using a fixed cableway or a large mobile crane would probably be too costly or otherwise infeasible, and were not assumed for the current cost estimates. The reconnaissance estimate is based on the use of a Skycrane to deliver and remove a Cat 311 excavator with hoe-ram (or equivalent) and other equipment (including air compressors) to the site.

b. Streamflow diversion. - Using the construction sequence and diversion assumptions outlined in the previous section, a streamflow diversion requirement of 30 ft^3/s was adopted for this study. The existing 30-inch-diameter pipe through the right end of the dam could be used to drain the reservoir under these flow conditions to about elevation 1074, or 0.7 feet below the existing dam crest, provided the canal pipeline is first removed from the downstream end of the 30-inch pipe. If the existing 24-inch-diameter sluiceway is also used, the reservoir could be drawn down to about elevation 1073.2, or 1.5 feet below the existing dam crest. Sediment accumulations at the intakes may have to be excavated prior to diversion, since the canal intake and sluiceway have not been used since 1995.

Excavation of a 3.5-foot-wide portion of the masonry dam at the fish ladder structure, to the original streambed grade, and subsequent breach of the fish ladder walls, would lower the reservoir an additional 4 feet, to about elevation 1069.

c. Structure removal. - Features to be removed at Wildcat Diversion Dam would include the masonry dam overflow and nonoverflow sections, the fish ladder structure, the gated sluiceway, and the canal pipeline. The power transmission line may be retained for the new streamflow gauge below the damsite. Retention of the left abutment nonoverflow section and the fish ladder would unnecessarily constrict the natural channel to about 27 feet, or less than one-half the natural channel widths at both the Wildcat and Eagle Canyon damsites. The fish ladder structure may also pose a potential public safety hazard if left intact, with a maximum pool depth of 6.5 feet and with walls up to 8 feet high. Portions of the

24-inch-diameter canal pipeline are currently used as an access walkway to the stream, and represent a potential public safety hazard from falls. Future deterioration of the abandoned steel pipeline and support structures, potential floatation of the empty pipe during flood flows, and simple aesthetics, would also warrant their removal. A potential candidate for retention, however, is the canal intake structure on the right abutment of the dam. Already equipped with an access walkway and handrails, the intake structure could provide a safe vantage point for inspection of the site following removal of the dam, or for access to the new streamflow gauge, while minimizing removal costs. Cost estimates for both partial and full dam removal are included in this study. All structures would be fully documented in an Historic American Engineering Record (HAER) for the damsite.

Using the available diversion capacity to maintain the reservoir level below the crest of the overflow section would allow demolition activities to begin on the dam crest. Excavation of a notch within the masonry structure using the excavator with hoe-ram and jackhammers would permit further lowering of the reservoir. Location of the notch within the existing fish ladder structure could provide some additional degree of control by limiting the differential head at the notch. Continued demolition of the masonry structure to the original streambed level would be performed by the excavator in the flow, with water depths averaging less than three feet. The cost estimates assume the masonry would readily break up at the mortared joints, and the masonry rubble would be spread out in the downstream channel. The concrete in the fish ladder structure, amounting to about 10 yd^3 (with a total weight of about 20 tons) could be flown out in pieces, including any reinforcing steel, using a helicopter and a skip or bucket. Alternative demolition methods using chemical expansion in drilled holes to promote cracking could also be considered. The use of explosives at this site may create unacceptable environmental, safety, and upper slope stability concerns of the rimrock on the canyon walls, and is strongly discouraged.

The cost estimate for partial removal assumes excavation of the masonry structure to the face of the intake structure, including removal of the 24-inch-diameter sluice gate, hoist, and pipe. The 36-inch-diameter slide gate, hoist, trashrack, and 15-foot-long section of 30-inch-diameter pipe would be retained, with the slide gate permanently closed and the downstream end of the pipe capped or plugged. Although the access walkway and handrails to the intake structure would be retained, all other miscellaneous metalwork, including CMP standpipes and automated control equipment, would be removed for salvage.

The 24-inch-diameter steel pipeline portion of the Wildcat Canal would be cut up and airlifted out in approximate 20-foot sections over much of its 5,530-foot length. Steel pipe supports, standpipes, and catwalk sections along the canal alignment would also be airlifted out. The cost estimate for full removal includes the complete removal of all concrete saddles and footings along the pipeline alignment, and removal of the canal intake structure and all miscellaneous metalwork.

Although both cost estimates include backfilling of the canal channel and removal of a county bridge crossing, a downstream landowner (Mr. Crawford) has reportedly expressed an interest in retaining a portion of the shallow canal section

and up to 400 or 500 feet of the steel pipeline for his own use, which may result in some reduction of the estimated removal cost. This would require suitable measures to prevent potential adverse impacts, however.

d. Site restoration. - The left abutment and channel sections would be removed to streambed grade, with all concrete removed and with the masonry rubble distributed across the downstream channel. The partial dam removal plan would retain the intake structure and ancillary items on the right abutment, as well as the concrete footings for the Wildcat canal pipeline. Sediment management at the site is discussed in Section G. A final site inspection should be performed following the winter and spring runoff to confirm the adequacy of the dam removal work.

2. Eagle Canyon Diversion Dam

a. Site access and mobilization. - Site access to Eagle Canyon Diversion Dam is provided by traveling approximately 1 mile north of Manton Road on an unimproved (dirt) road to a plateau (or south rim) above the dam, and by foot about 1/4 mile along a narrow trail to the left abutment of the dam. The damsite and the access road are located on private property. Necessary approvals for site access would have to be obtained from private landowners. Electric power (110 V) is currently available at the site via an overhead transmission line.

It is assumed that a contractor staging area would be established on the left abutment plateau. Construction equipment would probably be transported down to the damsite by helicopter, except for smaller equipment and tools that could be carried down along the existing trail. Helicopter service may be available from either Redding Air Services, Redding, California (phone 530-221-2851) or from Erickson Air-Crane Company, Central Point, Oregon (phone 541-664-7615). The use of a helicopter for site mobilization would probably require early removal of the power transmission line at the site. Potential alternative methods using a fixed cableway or a large mobile crane would probably be too costly or otherwise infeasible, and were not assumed for the current cost estimates. The reconnaissance estimate is based on the use of a Skycrane to deliver and remove a Cat 311 excavator with hoe-ram (or equivalent) and other equipment (including air compressors) to the site.

b. Streamflow diversion. - Using the construction sequence and diversion assumptions outlined in the previous section, a streamflow diversion requirement of 70 ft^3/s was adopted for this study. The existing 4- by 10-foot radial sluice gate through the center portion of the masonry dam would be used to draw the reservoir level down to about elevation 1406.2, which is 6.2 feet below the dam crest (at elevation 1412.4) and 3.4 feet below the weir crest (at elevation 1409.4). Subsequent demolition of the far right end of the dam would further lower the reservoir level to facilitate other dam removal activities.

c. Structure removal. - Features to be removed at Eagle Canyon Diversion Dam would include the masonry dam, the masonry weir crest structure, the radial gate structure, the Alaska Steeppass fish ladder, the concrete steppool structure, the metal canal flume structures, the concrete bench flume sections, and the power transmission line. Retention of the existing canal wall and gate winch block was assumed for the partial removal estimate to reduce removal costs and provide a

waste disposal area at the site, within the canal channel. The metal canal flume structures and the concrete bench flume sections would be removed for both cost estimates to avoid a potential public safety hazard and to restore the natural appearance of the canyon. The cost estimate for full removal includes the removal of all reinforced concrete footings along the metal flume alignment, and removal of the canal wall and gate winch block at the damsite. All structures would be fully documented in an Historic American Engineering Record (HAER) for the damsite.

Using the available diversion capacity to maintain the reservoir level below the crest of the dam and weir crest would allow demolition activities to begin in the dry. Excavation of the right end of the dam using the excavator with hoe-ram and jackhammers would permit further lowering of the reservoir, assuming the flow would erode a channel through the upstream sediments. Continued demolition of both masonry structures to the original streambed level would be performed by the excavator in the flow, with water depths averaging less than three feet. The cost estimates assume the masonry would readily break up at the mortared joints, and the masonry rubble would be spread out in the downstream channel. Waste concrete, including any reinforcing steel, would be airlifted out using a helicopter and a skip or bucket, or for the partial removal estimate, be placed behind the canal wall to the extent possible. The canal section at the damsite has an average width of about 10 feet and a minimum depth of about 5 feet, for a distance of 142 feet from the face of the dam to the upstream portal of tunnel No. 1. The existing canal wasteway gate would be permanently closed, and the gate hoist would be removed, for the partial removal estimate.

Alternative demolition methods using chemical expansion in drilled holes to promote cracking could also be considered. The use of explosives at this site may create unacceptable environmental, safety, and upper slope stability concerns of the rimrock on the canyon walls, and is strongly discouraged. A PG&E employee was killed near the damsite several years ago due to falling rock.

The cost estimates include removal of the 4- by 10-foot radial gate and winch, and of the 3.5- by 6-foot structural steel slide gate and Limitorque operator at the canal intake. The intake gate superstructure and metal roof, and CMP standpipes, would also be removed from the site. Retention of the existing metal stairway (constructed about 1985) and pipe handrails would provide safe access along the canal wall for inspection of the site following dam removal, and is assumed for the partial removal estimate to reduce costs. All PVC pipes and selected concrete and timber structures used by PG&E in the past to collect and divert spring flows into the canal should be removed to improve the appearance and safety of the existing trail to the damsite.

All accessible tunnel portals should be sealed to prevent entry, including both portals for the diversion tunnel at the damsite, the upstream portal of tunnel No. 1, and at least one other tunnel portal. The use of heavy steel security screens would permit future inspections of the tunnel conditions as required. Alternatively, the installation of tunnel supports (if needed) and concrete or masonry plugs at the portals may be considered for permanent closure. Both cost estimates assume the placement of concrete plugs at four tunnel portals. All concrete and forming materials are assumed to be delivered by helicopter.

The metal canal flume sections would have to be disassembled and bundled for removal by helicopter. The cost estimates assume all flume sheets and associated hardware would first be stacked in cradles for airlifting; followed by removal of the cross-beams, longitudinal bracing, and girders from alternating 20-foot spans, and bundling them with the adjacent framework sections. The framework sections with bundled pieces would be unbolted from their footings and airlifted out. Spillway sections, feeder pipes, access walkways, stairways, and other miscellaneous metalwork would also be removed. The weight estimates used for this study were provided by PG&E, based on the original construction quantities from 1980 to 1983 for a type #132 flume, with an additional allowance of 30 percent for I-beam footings, stairways, and other features. It is assumed that all metal items would be airlifted to the canyon rim, for possible use by private landowners or sale as scrap. Removal of the reinforced concrete footings (for the full removal estimate) assumes the footings would be demolished in place and airlifted out in a skip to a suitable disposal site. The reinforced "L-wall" portions of the concrete bench flumes would be sawcut and flown out in sections, and the gunite lining would be demolished and flown out in a skip.

The open channel portions of the Eagle Canyon Canal, with an 8-foot bottom width and a 4-foot depth, are assumed to remain intact for the current cost estimates; however, some minor modifications may be necessary for public safety purposes, to prevent potential injury to people or livestock.

d. Site restoration. - All portions of the masonry dam and upstream weir structures would be removed to the original streambed grade, with the rubble distributed across the downstream channel. Retention of the canal wall at the damsite for waste disposal (under the partial removal plan) would require the placement of gravel and cobbles from the reservoir sediments on top of the waste materials. The existing springs would flow across this backfill to the river channel. Sediment management at the site is discussed in Section G. A final site inspection should be performed following the winter and spring runoff to confirm the adequacy of the dam removal work.

3. Coleman Diversion Dam

a. Site access and mobilization. - Site access to Coleman Diversion Dam is provided by traveling approximately 1/4 mile south of Manton Road on a paved road to the right abutment of the dam. The damsite and access road are owned and maintained by PG&E. Electric power (110 V) is currently available at the site.

It is assumed that a contractor staging area would be established on the right abutment near the dam. Construction equipment would be transported to the site using the existing roads.

b. Streamflow diversion. - Using the construction sequence and diversion assumptions outlined in the previous section, a streamflow diversion requirement of 30 ft^3/s was adopted for this study. The existing 14- by 8-foot radial gate near the right end of the dam would be used to drain the reservoir under these flow conditions to about elevation 996.2, which is 7.1 feet below the dam crest (at

elevation 1003.3) and 6.1 feet below the weir crest (at elevation 1002.3). Excavation of a notch within the masonry dam to the original streambed grade would further reduce the reservoir level.

As noted previously, it may be possible to divert all natural streamflow into the Inskip Canal at Inskip Diversion Dam, and return 30 ft^3/s to the South Fork downstream of Coleman Diversion Dam, permitting complete unwatering of the damsite during construction using existing facilities. Alternatively, the construction of a temporary cofferdam and the installation of a fish screen at the Inskip Powerhouse tailrace could permit the diversion of all streamflow from South Fork Battle Creek into the Coleman Canal at the Inskip Powerhouse, to reduce potential environmental impacts associated with unwatering a greater portion of the stream. This should be evaluated further for future dam removal studies.

c. Structure removal. - Features to be removed at Coleman Diversion Dam would include the masonry dam overflow section with concrete overlay, the radial sluice gate structure, and the Alaska Steeppass fish ladder on the right abutment. The original fish ladder structure on the left abutment was abandoned in place about 20 years ago with no apparent problems, and is assumed to remain under the partial removal estimate to reduce demolition costs. Removal of the other structures would result in a channel width of about 100 feet, which is adequate. Retention of the Coleman Canal retaining wall and weir crest structure may facilitate construction of the direct pipe connection between the Inskip Powerhouse tailrace and the Coleman Canal. If retained, the stability of the existing wall should be checked for potential fill loads during final design, with a suitable tieback system (or buttress) added if necessary. All structures would be fully documented in an Historic American Engineering Record (HAER) for the damsite.

The cost estimates for this study assume that the direct pipe connection, to be designed by DWR, has been constructed prior to removal of the dam, and that the canal intake area has already been backfilled to the adjoining ground surface. This would provide a working area immediately adjacent to the dam for removal activities, and would also provide a streamflow bypass capacity necessary to minimize diversion requirements.

Using the available diversion capacity to maintain the reservoir level below the crest of the overflow section would allow demolition activities to begin on the dam crest. Excavation of a notch within the masonry structure to the original streambed grade, using a Cat 311 excavator with hoe-ram (or similar equipment) and jackhammers, would permit further lowering of the reservoir. Continued demolition of the masonry structure to the original streambed grade would be performed in the flow, with water depths averaging less than three feet. An excavator or a large dozer (such as a Caterpillar D-8 or D-9) could be used. The cost estimates assume the concrete overlay and the masonry would readily break up, and the masonry rubble would be spread across the downstream channel. The concrete sidewalls for the radial gate structure, the concrete box for the Alaska Steeppass fish ladder, and other waste concrete would be removed from the site for disposal in a suitable waste area. Alternative demolition methods using conventional drilling and blasting may be attractive at this site, due to the greater

height and thickness of the dam section compared to the Wildcat and Eagle Canyon Dams, and considering the accessibility of the site.

The cost estimate for partial removal assumes excavation of the masonry structure between the abandoned fish ladder on the left abutment and the canal wall on the right abutment, including removal of the 14- by 8- foot radial gate and hoist, the 2-foot-wide fish ladder gate and hoist, the Alaska Steeppass fish ladder, and the steel footbridge from the right abutment. Other miscellaneous metalwork to be removed includes the pipe handrails and CMP standpipes. The cost estimate for full removal includes removal of the abandoned fish ladder on the left abutment and of the masonry gravity weir structure on the right abutment. Any removal or modification of the existing Coleman Canal retaining wall are assumed to be included in the cost estimates for the direct connection pipe from the Inskip Powerhouse tailrace.

d. Site restoration. - The overflow portion of the masonry dam would be removed to the original streambed grade, with the rubble distributed across the downstream channel and the concrete waste removed from the site. The proposed partial removal plan would retain the original fish ladder structure on the left abutment, which has already been modified for abandonment, and the existing masonry gravity weir structure on the right abutment. Backfill behind the weir structure would be shaped and seeded to provide a natural appearance. Sediment management at the site is discussed in Section G, which may require the excavation of a new channel through the upstream sediment. A final site inspection should be performed following the winter and spring runoff to confirm the adequacy of the dam removal and upstream channelization work.

F. Waste Disposal

1. Construction Debris

Onsite disposal of construction debris should be used to the maximum practicable extent at all three damsites, to reduce costs. The masonry materials are believed to generally consist of rounded cobbles ranging between 6 inches and 2 feet in size, within a cement mortar matrix, and can safely be left within the stream channels, provided they are distributed sufficiently to prevent ponding. Waste concrete and other debris should be buried outside the stream channels, either within adjoining canals (as at Eagle Canyon Dam) or offsite. If a suitable disposal site cannot be found near each damsite, a commercial site, such as Anderson-Cottonwood Disposal (phone 530-221-4784), may be used. This study assumes disposal sites will be located within 1 mile of each damsite.

Mechanical items and miscellaneous metalwork removed from the damsites may have some commercial value, and should be salvaged to help offset removal costs, as well as for environmental (recycling) considerations, if practicable. Landowners in the area have reportedly expressed some interest in the 24-inch-diameter pipe from the Wildcat Canal, and the semicircular flume plate sections from the Eagle Canyon Canal. The California Department of Fish and Game has expressed interest in the Alaska Steeppass fish ladders at the dams, for potential use at other sites. The structural steel slide gate and Limitorque operator, and the access stairways, at Eagle